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DESCRIPTIONS OF A NEW SPECIES OF TROUT (*SALMO NELSONI*) AND A NEW CYPRINODONT (*FUNDULUS MEEKI*) WITH NOTES ON OTHER FISHES FROM LOWER CALIFORNIA.

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While carrying on biological explorations in the peninsula of Lower California in 1905 for the U. S. Bureau of Biological Survey, Mr. E. W. Nelson collected a few specimens of fishes. Through the courtesy of the Biological Survey these have been placed in my hands for identification. Although the collection is a small one, containing but 37 specimens representing only 5 species, it is of unusual interest because the specimens come from localities in which little or no collecting had previously been done, and because 2 of the species, a trout and a cyprinodont, prove to be new and undescribed.

The localities represented in the collection are four, namely: the San Ramon River, a small stream at San Ignacio, La Purisima Creek, and some small tide pools at San Felipe Bay.

Mr. Nelson has furnished the data for the following account of these various waters:

The Rio San Ramon has its rise at an altitude of about 7,000 feet in La Grulla meadows on the west side of the San Pedro Martir Mountains, about 150 miles south of the International boundary, and descends through a deep, narrow and precipitous canyon to the vicinity of San Antonio ranch. Below San Antonio the descent is more gentle and the stream winds through a rocky canyon most of the way to the sea. The San Ramon River is merely a small creek during ordinary times, but becomes a torrent during heavy rains. It is said to be the only stream in northern Lower California which always flows to the

sea; the other streams reach the sea only at times of flood and for an irregular period following rainy seasons. They sometimes disappear entirely during long dry periods. At the time of Mr. Nelson's visit (last of July, 1905), the San Ramon River at Rancho San Antonio was about 10 feet wide and 10 inches deep in the middle of the channel, where the current was about 6 miles an hour.

The San Pedro Martir Mountains are made up of a friable granite and the bed of the stream is granite, sand and gravel with many boulders often of huge size. About 12 miles above the San Antonio ranch there is a high waterfall beyond which fishes can not go in ascending the stream. Previous to the winter of 1903-4 there were several large pot-holes in the stream close to San Antonio in which trout were plentiful. During that winter there were excessively heavy rains in this region and the floods in the river brought down great quantities of boulders and other débris, filling the pot-holes in the lower portion of the canyon. The result of this was to destroy the haunts of the trout in that portion of the stream, so that trout are now found only sparingly in the vicinity of San Antonio. Several miles further up the canyon some pot-holes still exist in which trout are reported to be numerous. Trout occur in some numbers from a short distance below San Antonio up to the falls already mentioned, or throughout a distance of about 12 miles. The portion of the stream in which they occur is, according to Mr. Nelson, wholly below the limits of the pine forests. Near San Antonio only small trout are found, but higher up trout 12 to 15 inches long are said to occur. The largest examples seen by Mr. Nelson, however, did not exceed 8 inches in length. From his own observations and from information obtained from residents of the region, Mr. Nelson is convinced that the heavy floods referred to destroyed a considerable percentage of the trout in this stream.

The Cyprinodonts in the collection were obtained in a small stream which flows from large springs at San Ignacio, or approximately in north latitude  $27^{\circ} 10'$ . These springs rise just above the town of San Ignacio and produce a permanent stream about 30 feet wide and a foot deep which flows through a narrow valley for 10 or 12 miles before the water is lost in the sand. This water course extends to the sea and during rainy

seasons the stream sometimes reaches the coast. A few hundred yards below the springs are some large, deep pools. These fish abound throughout the entire length of the stream.

La Purisima Creek is a stream about 50 feet wide and 18 inches deep, flowing for 20 or 25 miles down a broad, fertile canyon in which is located the settlement known as La Purisima, about 35 miles south of Mulegé, or in north latitude 26°. This stream flows to the Pacific after heavy rains, but it usually loses itself in the sand and is there restricted to the middle of the peninsula. The large goby was found here.

It has never been definitely determined just how far south trout originally extended in the coastal streams of southern California. It has been said that trout are native to a stream near San Luis Rey in the northern part of San Diego County, but the authority for the statement is not known.

A new species of trout\* has recently been discovered in the headwaters of South Fork of the Santa Ana River at an altitude of 8,200 feet, near San Gorgonio Peak in the San Bernardino Mountains; and rainbow trout have been introduced into the lower portion of the Santa Ana as well as into many other streams in southern California. A comparison of the specimens of the San Gorgonio and the San Pedro Martir trouts shows them to be very distinct species.

The most southern stream in California in which I have personally taken native trout is Santa Paula Creek, Ventura County, about 200 miles north of the International boundary, or 300 miles from the stream in which the Lower California trout are found. Other small streams in Ventura County contain trout; namely, the Sespí, Sisa, Matillija, and perhaps others, all small streams which dry up in their lower courses during the summer and fall. The trout in these streams is a small species, seldom exceeding 6 or 8 inches in length, brightly colored and possibly identical with the typical rainbow trout, *Salmo irideus*.

Trout have been reported from at least three other localities in Mexico besides the San Pedro Martir Mountains of Lower California.

In 1886, Cope† recorded trout from Mexico in the following note:

\* This species is described by Jordan and Grinnell in these Proceedings, pp. 31, 32.

† American Naturalist, XX, August, 1886, 735.

The Most Southern Salmon.—I owe to my friend, Professor Lupton, two specimens of a black-spotted trout from a locality far south of any which has hitherto yielded Salmonidae. They are from streams of the Sierra Madre, of Mexico, at an elevation of between 7,000 and 8,000 feet, in the southern part of the State of Chihuahua, near the boundaries of Durango and Sinaloa. The specimens are young, and have teeth on the basihyal bones, as in *Salmo purpuratus*, which they otherwise resemble.

Mr. E. W. Nelson visited that locality in August, 1898. He informs me that all the streams of that region flow into the Pacific and that the particular stream in which the trout occurs is a small creek rising on the slopes of Mt. Mohinora, a few miles south of the mining town of Guadalupe y Calvo, Chihuahua. Mt. Mohinora is the highest mountain in the Sierra Madre between the United States border and the high peaks about the southern end of the tableland in Michoacan. The stream in which the trout occur is only 15 to 20 feet wide and a foot or so deep and is, Mr. Nelson thinks, one of the headwaters of the Rio Culiacan.

Dr. Meek states\* that he was informed by Mr. A. V. Temple of the Mexican Central R. R., that trout are "found in the Pacific coast streams west of the City of Durango."

This place also was visited by Mr. Nelson in July, 1898. He saw trout in a small creek at El Salto, Durango, a small ranch in a pine-forested plateau of the Sierra Madre over 7,000 feet above sea level and 70 miles south of west from the city of Durango. This stream is about 25 feet wide and a foot deep and is one of the headwaters of one of the rivers flowing into the Pacific not far from Mazatlan in Sinaloa, probably the Rio del Presidio in north latitude about 24°. Mr. Nelson is not entirely certain on this point. He states that the trout of this stream, as well as those near Guadalupe y Calvo are all small, reaching only 5 to 10 inches in length, and that they are not numerous in either place. Both localities are wholly within the yellow pine forest. He has never heard of trout in Mexico in any stream draining into the Rio Grande basin.†

\*The Freshwater Fishes of Mexico north of the Isthmus of Tehuantepec. Field Columbian Museum Publication 93, Zoological Series, Vol. V, 97, September 23, 1904.

† Since the above was written, Mr. Nelson has received 5 excellent specimens of trout from El Salto, where they were collected in the fall of 1907 by the Hon. W. C. Bishop, U. S. Vice Consul, at Durango City, Durango. An examination of these specimens shows them to be very distinct from the San Pedro Martir trout. They will be described in a later paper.

The fourth locality in Mexico from which trout have been reported is the headwaters of the Rio Yaqui. The exact locality is not known; it may be in northeastern Sonora or in northwestern Chihuahua. The occurrence of trout in this region is mentioned by Dr. Meek,\* on the authority of Mr. John Ramsey, General Manager of the R. G., S. M. & P. R. R., who says "that a trout is quite abundant in the upper tributaries of the Rio Yaqui."

Dr. Meek inadvertently records this trout as a member of the Colorado River fauna under the name *Salmo irideus*, which, of course, is quite erroneous, as the trout of that river is not a rainbow trout, but one of the cutthroat series, *Salmo pleuriticus*. There is considerable geologic evidence that the portions of the western rivers in this region which are east of the Sierra Madre Mountains were formerly the upper tributaries of streams flowing eastward. Some of the streams flowing to the Gulf of California have cut their way back, thus capturing the headwaters of the eastern streams and with them their portion of the eastern fish-fauna. †

This explanation would account for trout in the headwaters of the Rio Yaqui, but would give them a Rio Grande origin which would make them *Salmo spilurus* or a derivative from that species. This may also be the origin of the trout which occur in the streams west of Durango. But it is wholly improbable that trout could have reached western drainage in Lower California from the Rio Grande; the origin of the San Pedro Martir trout must be explained in some other way.

Trout are known to occur in Arizona in a number of mountain streams all of which, however, are tributary to the Colorado. Between these streams and Lower California lies the broad semi-desert region of northern Sonora, the Gulf of California, and the eastern portion of the peninsula, a desert region on the west of which are impassable mountains, beyond which lies the stream in which the trout are found. Trout might have come down the Colorado, but they would have met these same impassable barriers. And westward from the lower course of the Colorado is the broad expanse of desert across which trout can not now possibly pass. What may have been the conditions long ago can not, of course, be definitely known, but it is con-

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\* See Meek, op. cit. p. XXVII.

† Meek, op. cit. p. 96.

ceivable that, when the deserts of Panamint and Amargosa were great lakes or inland seas, trout may have been able to reach Pacific drainage in the northern part of Lower California. From what is known of the geological and hydrographic history of the region this, however, is a remote possibility.

These same difficulties are encountered in considering the possible origin of the Lower California trout from the southern High Sierra. The same deserts were to cross and the distance is greater, unless they came down via Tehachapi Pass and the San Bernardino and San Jacinto ranges, which would have brought them over to the coastal streams.

These coastal streams, however, were probably stocked from other Coast Range streams farther north. This extension was accomplished, in all probability through short journeys in the sea from the mouth of one stream to that of the next. In this way trout succeeded in extending their range as far down the coast as the mouth of the San Luis Rey, if that be a natural trout stream, as has been reported. From that stream, in exceptionally favorable seasons they could have extended their range southward to the mouth of the Rio San Ramon, a distance of approximately 100 miles. This may have been accomplished in a single advance or intervening streams may have been utilized and the advance made in two or more stages. The intervening streams such as the San Diego and the Sweetwater are not known to contain trout and some of them do not ordinarily reach the sea. It is not improbable that they formerly were better suited to trout and that trout may have inhabited them at one time.

Still more conclusive evidence that the San Ramon River was stocked from the sea, or at least that the trout *ascended* the river is found in the fact that there are no trout in its headwaters. The San Ramon has its sources among the highest parts of the Sierra San Pedro Martir. About 12 miles above Rancho San Antonio is a considerable fall which trout can not possibly ascend, and above these falls it is said that trout are not found.

These geographic facts, together with the fact that the Lower California trout is a rainbow trout rather than a cutthroat, lead to the conclusion that the Rio San Ramon in all probability was originally stocked with trout from the coastal streams to



the northward, the trout passing through the sea along the coast from stream to stream until the San Ramon was reached.

It has been suggested that the trout were introduced into the San Ramon by the early Spanish padres many years ago. To have accomplished such a feat successfully would have required a knowledge of fish-cultural methods and a skill in handling and transporting live fish which we have no reason to believe were possessed by the padres. It would be a feat extremely difficult of accomplishment even to-day. That the padres were able to carry live trout hundreds of miles on pack animals across a semi-desert or in a sailing vessel for more than a hundred miles is highly improbable. The difficulties are too great to permit the acceptance of this theory. Moreover, the trout themselves possess characters which preclude the possibility of identifying them with any known species in any of the streams of California, Arizona, Chihuahua, or elsewhere.

We are, therefore, led to the conclusion that the Rio San Ramon of the San Pedro Martir was stocked with trout by natural extension from trout waters of the coast region of southern California and at a period sufficiently remote to have allowed ample time for its specific differentiation.

**Fundulus meeki** Evermann, sp. nov.

Figure 1.

Head 3.1 in length to base of caudal; depth 3.4; eye 4.5 in head; snout 4; interorbital 2.7; D. 12; A. 12; scales 34-13.

Body short and stout; profile from tip of snout to highest part of back, which is in vertical above base of pectoral, rising rather rapidly and in a straight line, descending slightly thence to dorsal fin along the base of which it drops more rapidly to caudal peduncle whose dorsal and ventral lines are approximately parallel; ventral outline little convex; greatest width of body at pectorals 1.5 in depth; head large, flat, the interorbital broad; eye small; snout rather long and pointed; teeth in a narrow band in each jaw, those of outer series enlarged, subequal, pointed, firm, the tips not dark; caudal peduncle (measured from base of last anal ray to base of caudal fin) 1.4 in head, its least width 3 in its least depth, which is 1.5 in its length; scales rather large, about 25 on median line of back from front of dorsal to snout. Fins small; origin of anal under middle of dorsal, their rays about equal in length and equal to snout and eye; caudal truncate; ventrals small; pectoral 2 in head.

Intestine short, peritoneum black. Color in spirits, back grayish olive, middle of side with a broad more or less interrupted blackish band most distinct posteriorly and in the young, in which it tends to break up in

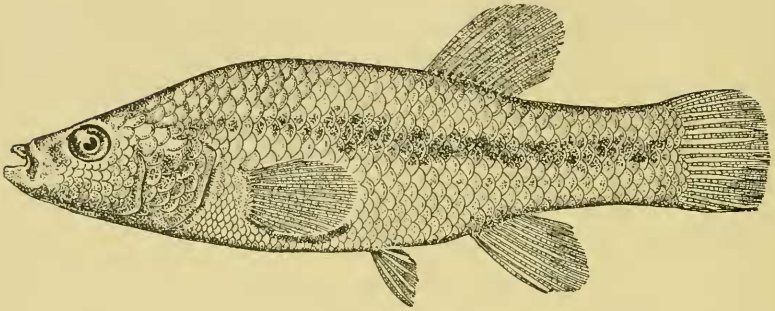


Figure 1.  
*Fundulus meeki* Evermann. Type.

large spots; below this a less distinct series of blackish spots, all these marks varying much in distinctness; lower part of side and ventral surface yellowish white; fins all dusky.

In the male (cotype, No. 61,059, U. S. N. M.) the scales are exceedingly rough, particularly along the side and on the caudal peduncle, this roughness being due to small, sharp, spinelike tubercles on the posterior edge of the scales. The males differ from the females also in being much darker in color.

Type, No. 61,058, U. S. N. M., a female 3.25 inches long, collected October 8, 1905, by Mr. E. W. Nelson, from a small stream flowing from large springs at San Ignacio, central Lower California. Cotypes, 2 males and 16 females ranging in length by from 2 to 3 $\frac{3}{8}$  inches, all collected by Mr. Nelson from the same stream. One or more of these cotypes have been deposited in each of the following museums: U. S. National Museum, U. S. Bureau of Fisheries (No. 1619), Stanford University, Field Museum of Natural History, American Museum of Natural History, Indiana University and Museum of Comparative Zoology.

It is with peculiar pleasure that I name this new species of *Fundulus* for my life-long friend, Dr. Seth Eugene Meek, Assistant Curator of Zoology in the Field Museum of Natural History, in recognition of his excellent work on the geographic distribution of the freshwater fishes of Mexico, and with pleasant memories of the days when we were jointly preparing our first paper in systematic ichthyology.

***Salmo nelsoni*** Evermann, sp. nov.

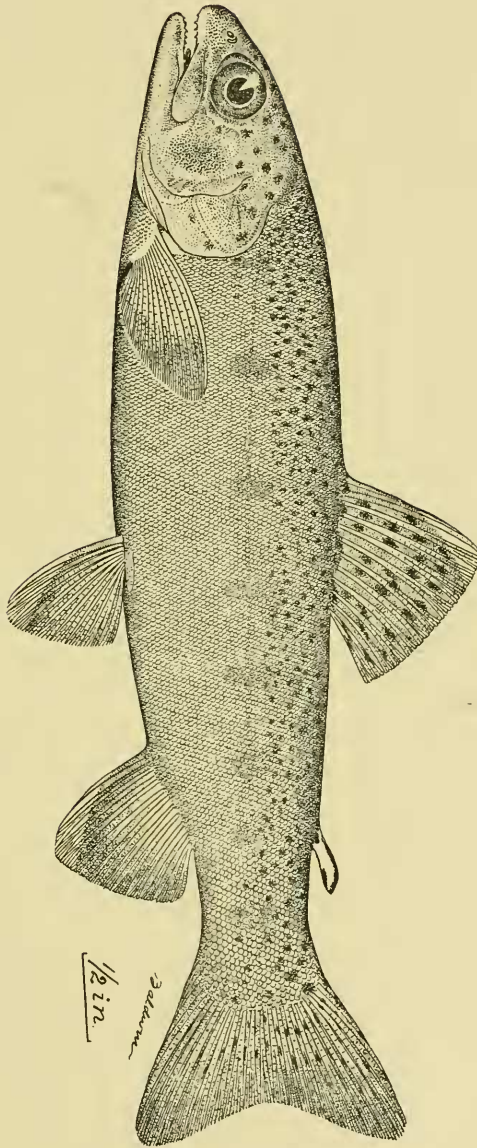
LOWER CALIFORNIA TROUT. Plate I.

Description of the type, a specimen 165 mm. in length to tip of caudal fin:

Head 3.75 in length to base of caudal; depth 4; eye 4 in head; snout 4; maxillary 2.1; mandible 1.8; D. 10; A. 10; scales 38-170-26, about 117 pores.



*Salmo nelsoni* Evermann. Type.





Body rather slender, the dorsal and ventral outlines little arched; head short, snout short and blunt, equal to eye in length; lower jaw slightly included; maxillary short, nearly straight, little expanded at tip, scarcely reaching vertical at posterior edge of orbit; eye large, equal to length of snout; teeth on jaws and maxillaries in a single row, those on vomer and tongue in a double row and well developed; gillrakers 3 + 9 or 4 + 8, short, stout and flat, 3 in eyes; caudal peduncle stout, its least width 3 in its least depth which is 2.3 in head.

Fins all rather small; pectoral short and rounded, its length 1.5 in head; origin of dorsal midway between tip of snout and base of caudal fin, base of fin equal to length of longest ray which is 2 in head, distal edge nearly straight; base of anal shorter than longest rays, which are a trifle shorter than longest dorsal rays; caudal forked, the lobes bluntly pointed, their length 1.4 in head; ventrals short, not reaching vent, 1.8 in head.

Scales very small, reduced in size and much crowded anteriorly; lateral line well developed; small scales on base of caudal fin.

Color in life (from field notes furnished by Mr. Nelson), back and top of head olive, shading down into silvery on the opercle and on side below lateral line; ventral surface dull white; throat white; back and upper part of side with small black spots and showing a slight golden bronze luster strongest along lateral line and fading below into silvery; a rather indistinct light reddish purple band across opercle and along side to caudal fin, this appearing to overlie the ground-color; dorsal and caudal fins grayish olive, with black spots; adipose fin olive, spotted with black; pectoral fins plain, dingy grayish; ventral fins dull olive with a terminal band of white at tip; anal fin olive, mottled indistinctly with blackish and edged on tips of anterior rays with an oblique band of white; eyes dull olive-brown, with golden luster. (Some small examples had the pectoral and ventral fins distinctly yellowish).

Color in spirits, caudal peduncle and entire side above lateral line closely covered with small stellate or irregular black spots; top of head somewhat less thickly covered with roundish black spots and a few similar spots on upper part of opercle; body below lateral line with smaller, less distinct spots; about 11 oblong vertical parr-marks on side (most distinct in smaller examples); dorsal fins with about 5 rows of rather larger black spots, a subterminal black area on anterior rays which are tipped with light orange; caudal spotted with black, the spots smaller than those on dorsal; anal dusky, tips of anterior rays light orange or whitish; pectorals and ventrals slightly dusky, the latter white-tipped.

Type, No. 61,056, U. S. National Museum, a specimen 165 mm. long, collected July 30, 1905, by Mr. E. W. Nelson from San Ramon River at Rancho San Antonio (altitude 2,000 feet), in the San Pedro Martir Mountains, 35 miles northeast of Port San Quintin, Lower California.

The eight cotypes have been deposited one in each of the following museums: U. S. National Museum (No. 61,057), U. S. Bureau of Fisheries (No. 1620), Stanford University, Museum of Comparative Zoology, American Museum of Natural History, Indiana University, and Field Museum of Natural History.

Comparative measurements of the type and 8 cotypes are given in the following table:

No.	Total length in mm.	Standard length in mm.	Head in mm.	Depth in mm.	Eye in mm.	Snout in mm.	Maxillary in mm.	Mandible in mm.	Dorsal.	Anal.
4498	165	138	38	35	10	10	19	22	11	12
4499	155	133	36	34	10	10	19	22	10	11
4500	145	132	38	33	10	9	20	22	11	11
4501	177	152	43	36	12	12	24	26	11	11
4502	133	116	32	30	9	9	17	18	11	11
4503	125	110	29	28	8	8	14	15	12	12
4504	125	110	30	30	8	8	15	16	11	11
4505	130	114	30	29	9	9	17	18	12	11
4506	130	114	32	26	9	9	18	19	11	11

From the above table it may be seen that the characters of the species are quite constant. There is some variation in color, the smaller examples being more fully spotted. I have been able to compare the Lower California specimens with specimens of trout of the same size from the Rio Grande and the Kern River region and with somewhat larger examples from the Colorado and Sacramento rivers. Compared with the Colorado River trout (*Salmo pleuriticus*), this species is found to differ in the much larger eye, shorter, blunter and more rounded snout, much shorter maxillary, rather more posterior position of the dorsal fin, the smaller size of the spots on the body, the fewer spots below lateral line, and the brightly colored tips of the dorsal, anal and ventral fins. From the Rio Grande trout (*Salmo spilurus*),\* it differs in the larger eye, shorter maxillary, and in the coloration, which is markedly different. In the present species, the spots on the back and upper part of side are irregular in shape and closely placed; below the lateral line there are few, if any, spots, except in the smaller individuals. The Rio Grande trout has the spots on back and side more nearly round and regular in shape, and more widely scattered, and there are similar spots, though less numerous, below lateral line; and the dorsal, anal and ventrals are not tipped with white or orange.

The present species belongs, however, to the Rainbow trout series and is more closely related to the Kern River trout and the various species of Golden trout of the Kern River region, agreeing with them in the small scales, the position of the dorsal, and the bright tips to the dorsal, anal and ventral fins. The black spots as to their character and distribution resemble somewhat those of the Kern River trout, but even in this respect the differences are marked. All the trout of the Kern River region have the maxillary longer, the snout longer and more pointed and the fins larger.

Specimens of trout from coastal streams of southern California are not at hand and no direct comparison has been made between examples from that region and the Lower California trout.

\* Specimens of same size from Del Norte, Colorado.